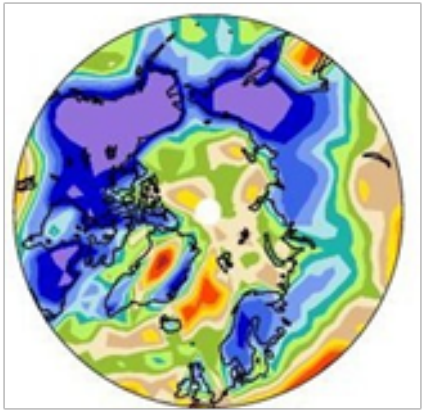
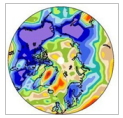


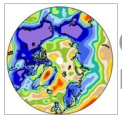
# Atmospheric Model Working Group Diagnostics Package

Andrew Gettelman



# ‘AMWG’ Diagnostics: Purpose

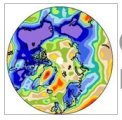
- Quick look at model results
- Compare a model to standard sets of observations
- Compare 2 model runs to look at differences
- Day-to-Day development work (mostly)
- Can also be customized



# Diagnostics: Example

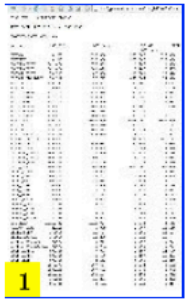
- What does the package do?
  - Tables
  - Various types of plots
  - 'Taylor diagrams'
- Compares run to observations or 2 runs
- Example:

  http://www.cgd.ucar.edu/amp/tutorial/test-obs/

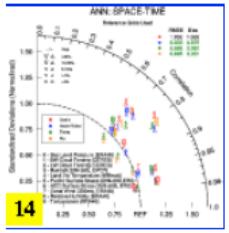


## Set Description

1 Tables of ANN, DJF, JJA, global and regional means and RMSE.
2 Line plots of annual implied northward transports.
3 Line plots of DJF, JJA and ANN zonal means
4 Vertical contour plots of DJF, JJA and ANN zonal means
4a Vertical (XZ) contour plots of DJF, JJA and ANN meridional means
5 Horizontal contour plots of DJF, JJA and ANN means
6 Horizontal vector plots of DJF, JJA and ANN means
7 Polar contour and vector plots of DJF, JJA and ANN means
8 Annual cycle contour plots of zonal means
9 Horizontal contour plots of DJF-JJA differences
10 Annual cycle line plots of global means
11 Pacific annual cycle, Scatter plot plots
12 Vertical profile plots from 17 selected stations
13 ISCCP cloud simulator plots
14 Taylor Diagram plots
15 Annual Cycles at Select Stations plots

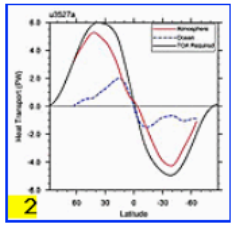


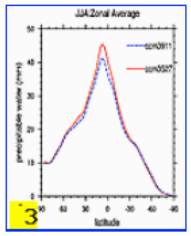

TABLES

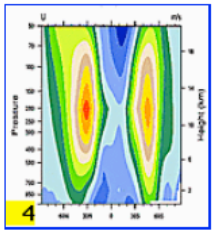


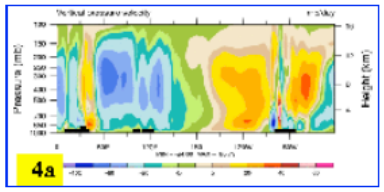

METRICS

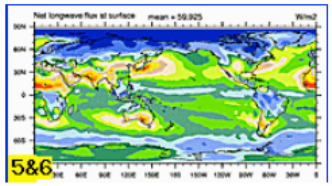
*Click on Plot Type*

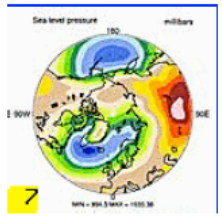


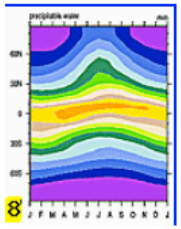



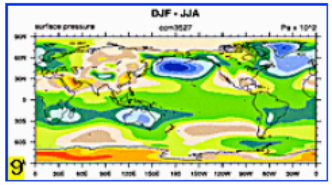



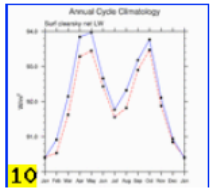



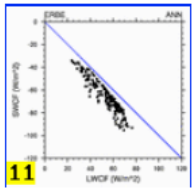



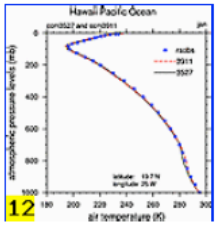



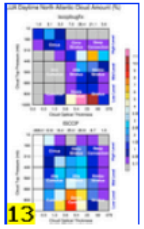



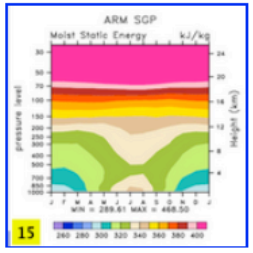



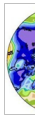



# Tables

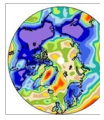
Note: Multiple Observations that Differ!

DIAG SET 1: ANN MEANS GLOBAL

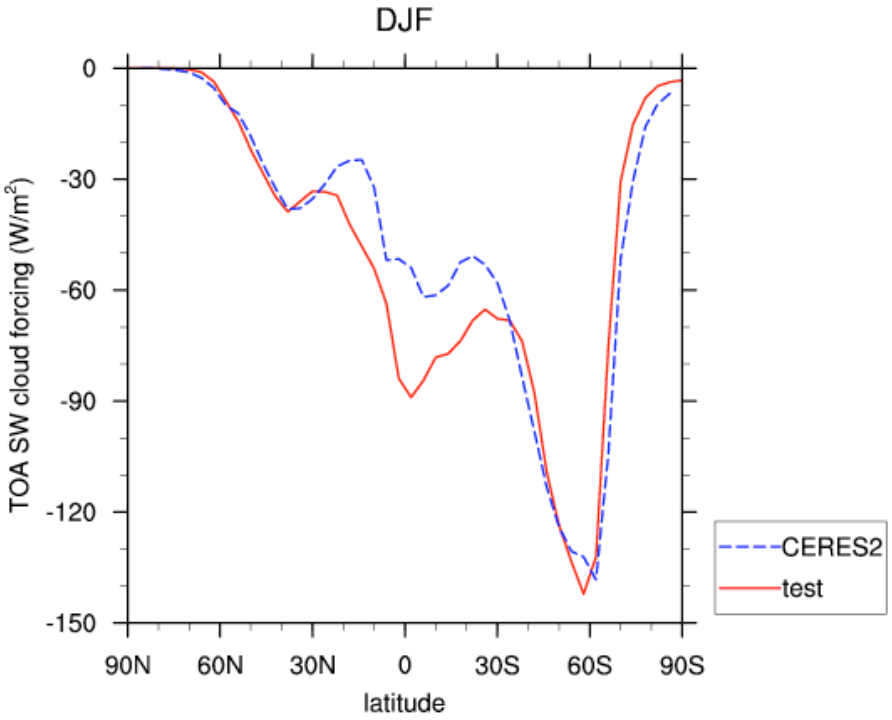
TEST CASE: test (yrs 1-2)

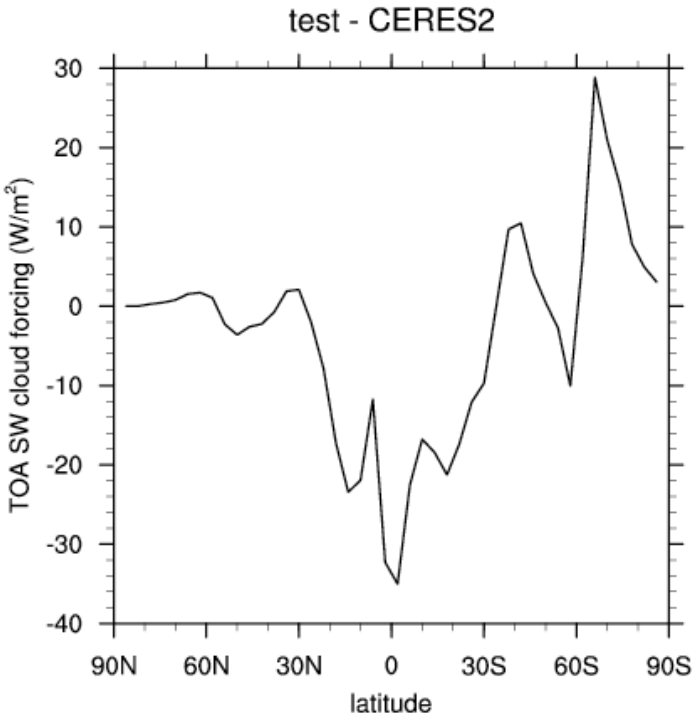
CONTROL CASE: OBS data

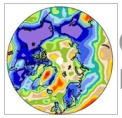
| Variable | test | OBS data | test -OBS data | RMSE |
|---|---|---|---|---|
| RESTOM | 1.042 | -999.000 | -999.000 | -999.000 |
| RESSURF | 1.083 | -999.000 | -999.000 | -999.000 |
| RESTOA_CERES2 | 2.972 | 0.815 | 2.158 | 13.483 |
| RESTOA_ERBE | 2.972 | 0.059 | 2.914 | 12.722 |
| SOLIN_CERES2 | 340.335 | 339.896 | 0.438 | 0.763 |
| SOLIN_CERES | 340.335 | 341.479 | -1.144 | 1.078 |
| CLDTOT_ISCCP | 54.575 | 66.800 | -12.225 | 17.013 |
| CLDTOT_CLOUDSAT | 54.575 | 72.213 | -17.638 | 20.204 |
| FLDS_ISCCP | 339.914 | 343.347 | -3.433 | 14.110 |
| FLNS_ISCCP | 57.448 | 49.425 | 8.023 | 16.305 |
| FLUT_CERES2 | 232.634 | 239.568 | -6.934 | 13.456 |
| FLUT_CERES | 232.634 | 238.963 | -6.329 | 12.979 |
| FLUT_ERBE | 232.634 | 233.946 | -1.312 | 11.435 |
| FLUTC_CERES2 | 261.974 | 269.464 | -7.490 | 9.127 |
| FLUTC_CERES | 261.974 | 266.878 | -4.904 | 7.922 |
| FLUTC_ERBE | 261.974 | 264.429 | -2.455 | 5.757 |
| FLNT_CAM | 231.505 | -999.000 | -999.000 | -999.000 |
| FSDS_ISCCP | 181.558 | 189.390 | -7.832 | 22.796 |
| FSNS_ISCCP | 159.133 | 165.893 | -6.760 | 20.420 |
| FSNS_LARYEA | 159.133 | 154.089 | 5.044 | 27.045 |
| FSNTOA_CERES2 | 235.606 | 240.383 | -4.777 | 18.129 |
| FSNTOA_CERES | 235.606 | 244.691 | -9.085 | 20.656 |
| FSNTOA_ERBE | 235.606 | 234.004 | 1.602 | 17.046 |
| FSNTOAC_CERES2 | 291.225 | 287.456 | 3.770 | 6.944 |
| FSNTOAC_CERES | 291.225 | 294.702 | -3.477 | 14.984 |



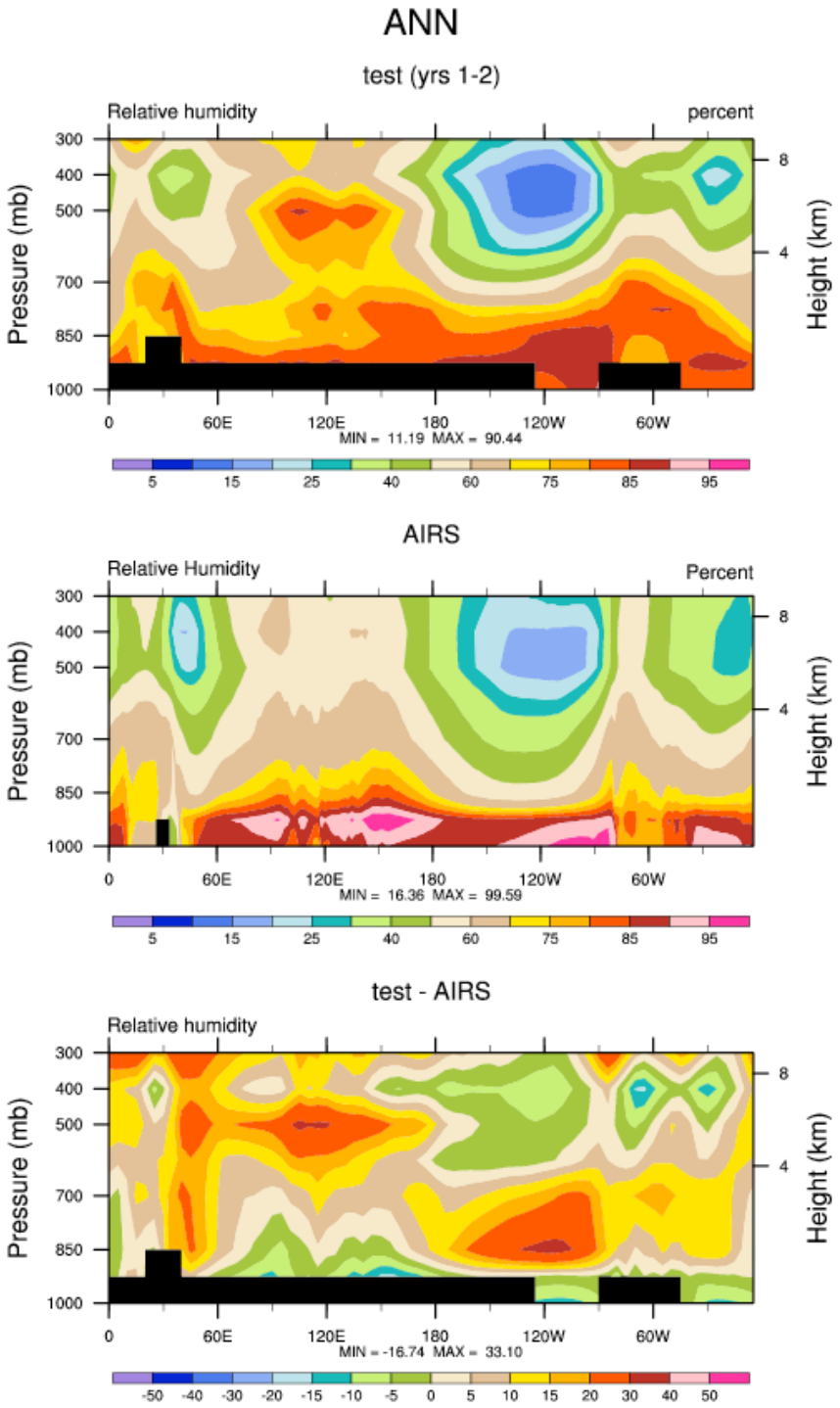
# Zonal Mean Line Plots



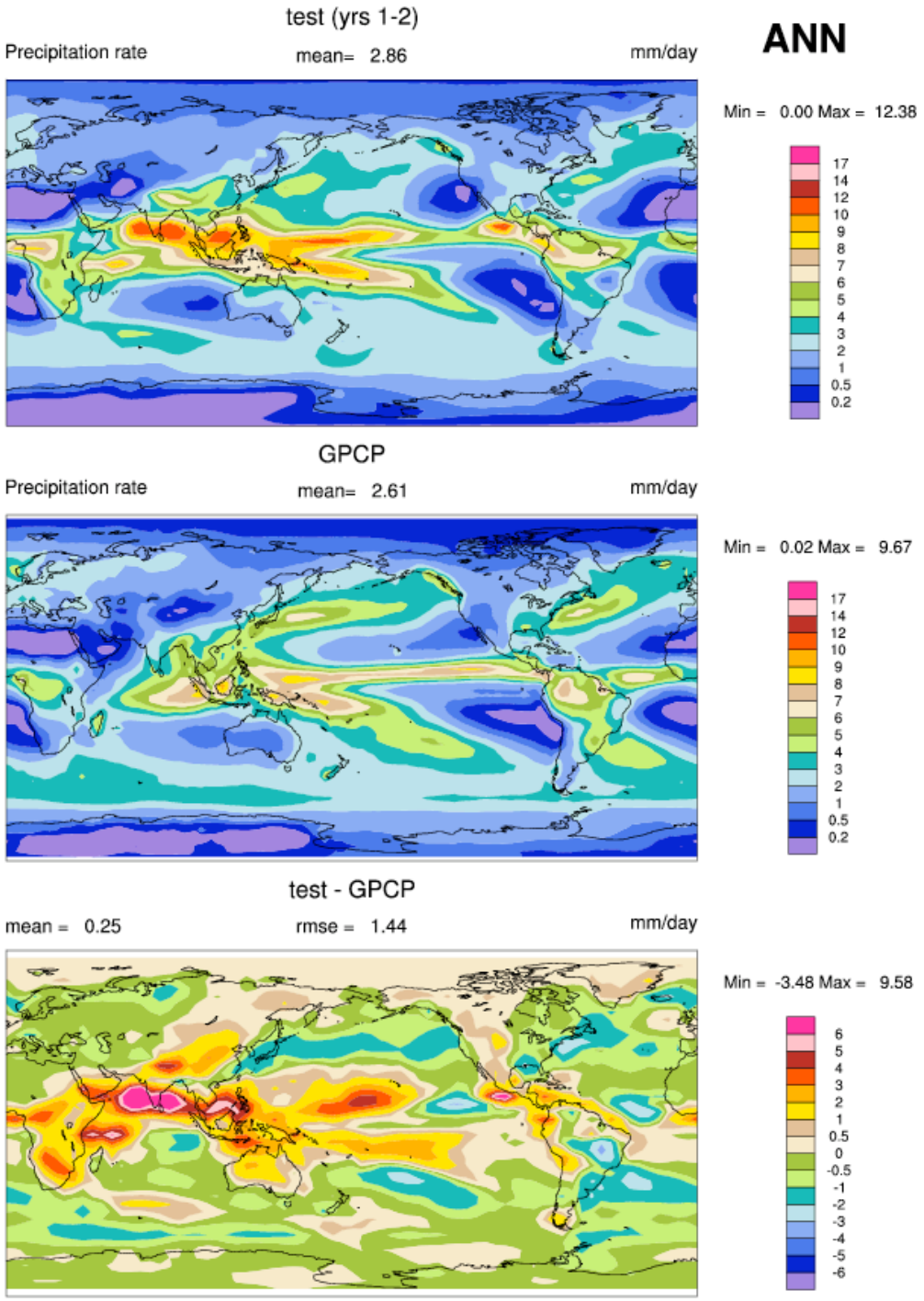



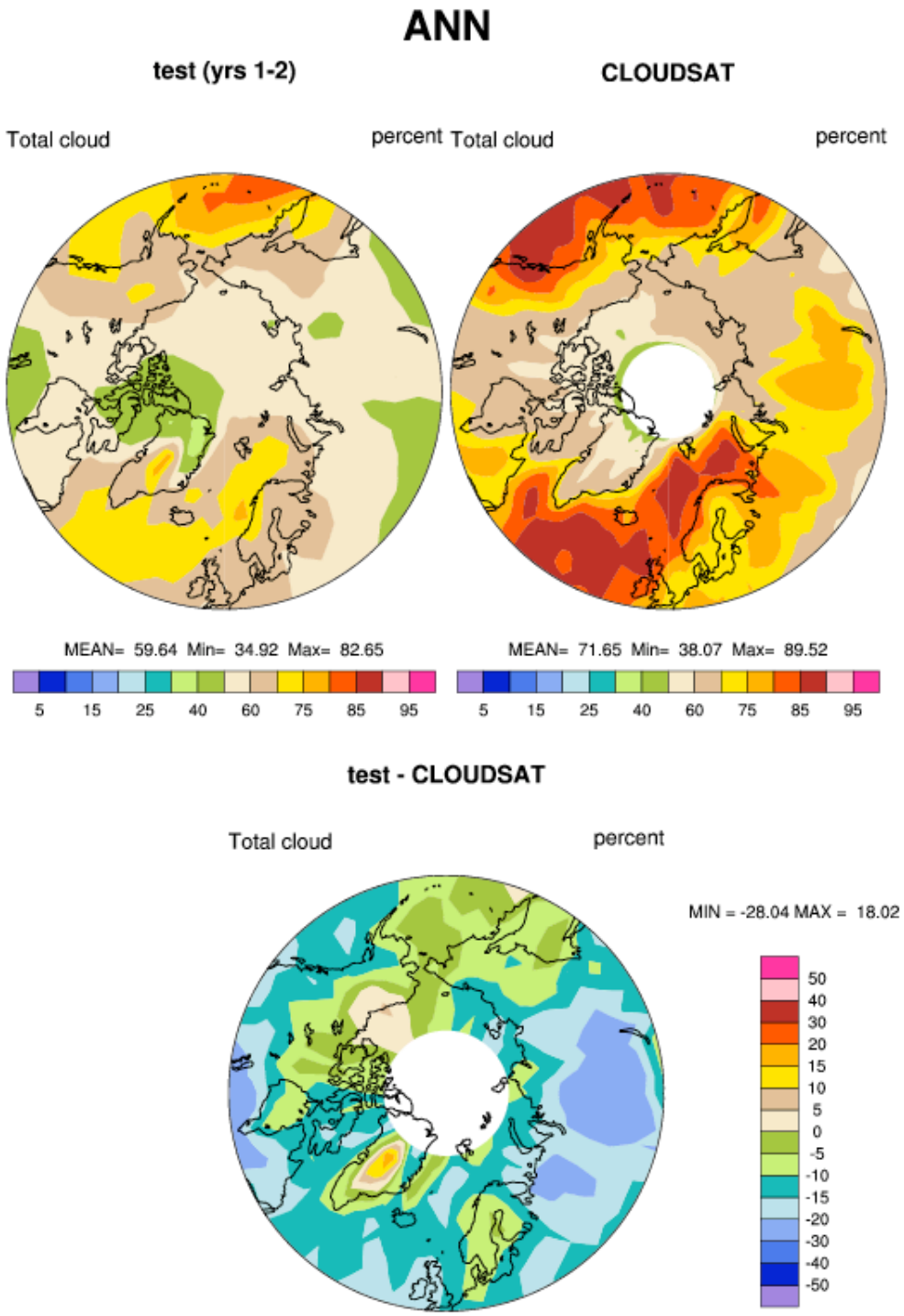
# Cross Sections



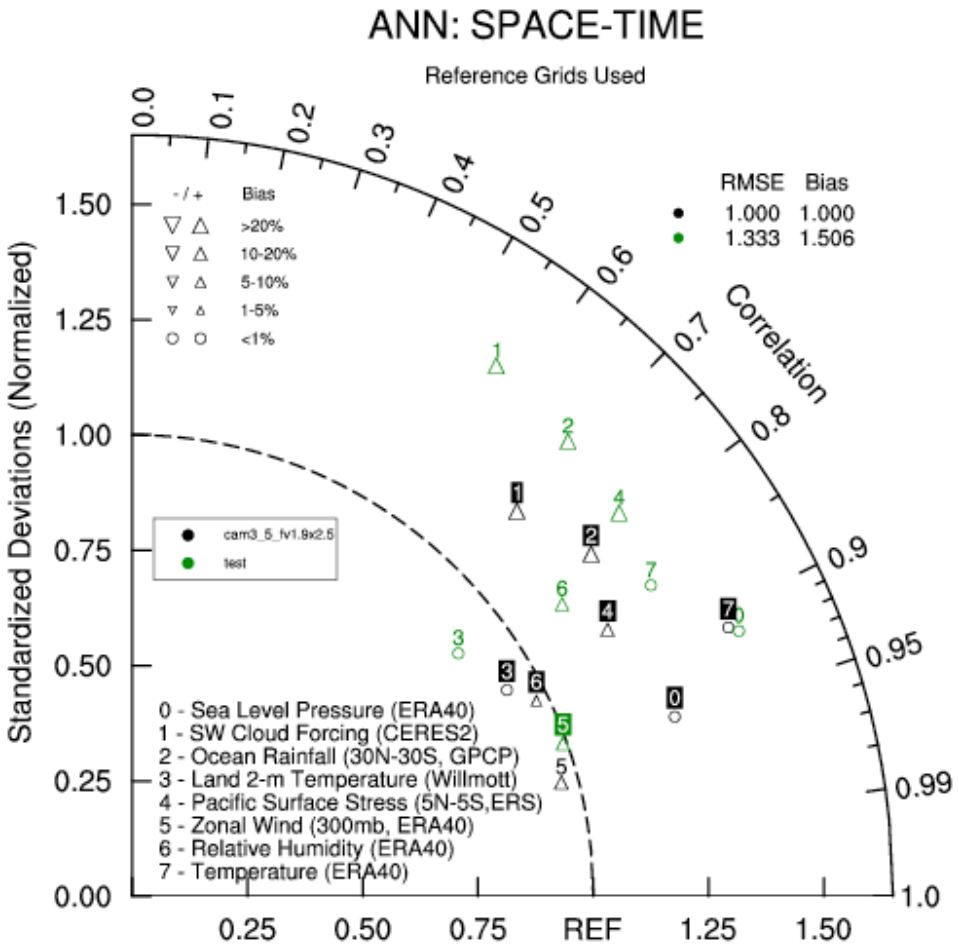
# Maps


test (yrs 1-2)
Precipitation rate
mean= 2.86
mm/day
ANN
Min = 0.00 Max = 12.38
17
14
12
10
9
8
7
6
5
4
3
2
1
0.5
0.2
GPCP
Precipitation rate
mean= 2.61
mm/day
Min = 0.02 Max = 9.67
17
14
12
10
9
8
7
6
5
4
3
2
1
0.5
0.2
test - GPCP
mean = 0.25
rmse = 1.44
mm/day
Min = -3.48 Max = 9.58
6
5
4
3
2
1
0.5
0
-0.5
-1
-2
-3
-4
-5
-6

# Polar Plots

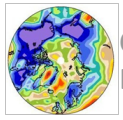

ANN
test (yrs 1-2)
CLOUDSAT
Total cloud
percent
Total cloud
percent
MEAN= 59.64 Min= 34.92 Max= 82.65
MEAN= 71.65 Min= 38.07 Max= 89.52
5 15 25 40 60 75 85 95
5 15 25 40 60 75 85 95
test - CLOUDSAT
Total cloud
percent
MIN = -28.04 MAX = 18.02
50
40
30
20
15
10
5
0
-5
-10
-15
-20
-30
-40
-50

# Taylor Diagrams



# How does it work?

- Shell script
- Uses NetCDF Operators (NCO)
  - Process CAM output files into annual & seasonal climatologies
- NCAR Command Language (NCL) for plotting
  - Good open source plotting package
- Transforms plots (postscript → png)
- Constructs a web tree
- View plots via a browser



# What do you need to run it?

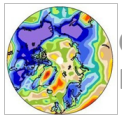
- NCO and NCL installed on a machine
- Diagnostic code and data sets
- 14 months of monthly mean model output

  (Jan – Dec of one year & Jan – Feb of the next)

  – 1 or 2 models

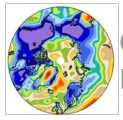
  – Can be any number of years > 1 (3, 5, 25)
- Practically: run 2 or more years

  – Throw out 11 months for spin up



# Exercises

- Questions?
- From here, you can do diagnostic exercises yourself
  - Run the diagnostic script (1 run)
  - Look at the output
  - Think about and discuss the results
  - Analyze 2 cases together
  - Look at the climatology netCDF files

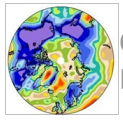


# Exercise: running the diagnostics

We will do a diagnostic test of your case (or one that has been run) against observations ('OBS')

1. Log into storm

```
ssh –Y gate.ucar.edu (Cryptocard Login)
storm4.scd.ucar.edu
```



# Set Up Paths/Directories

2. Make a directory for the script

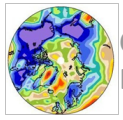
`/fs/home/$USER/diag`

3. Make an output directory

`/ptmp/$USER/diag`

4. Copy script to a directory on storm

cp /fs/home/andrew/diag/diag_tutorial.csh  /fs/home/$USER/diag



# 5. Edit the script

Set up correct paths and cases:

-Case names (L85: `cntl and test`)

The remaining options should be set already:

-Working directory (L88: `/ptmp/$USER/diag`)

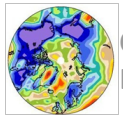
-Check 'OBS' as control (L94)

-Change times: start year and nyears (L107)

-Calculate climatologies flag (L113) (yes or no)

-Set the path for filenames (L131)

-For 2 model comparison, set control = 'USER' & Repeat last 3 as necessary



# 6. Run Script

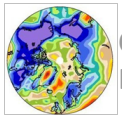
Run using:

```
./diag_tutorial.csh > diag.log &
```

While running, you can look at the output file to see what it is doing

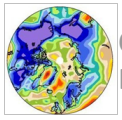
```
less diag.log
```

(Run takes about 10 minutes)



# Visualize Script

- When complete (about 10 minutes)
- ftp tar file back to a laptop:
  - 2 steps: see next slide
- Untar on local machine
- Load `index.html` into a web browser
- What do you see?
  - Key aspects of the simulation



# FTP Instructions

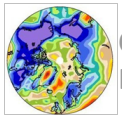
- From storm or bluefire:

```
ftp ftp.cgd.ucar.edu
login: anonymous, pass: email
cd incoming
put [file]
```

- From local machine (laptop)

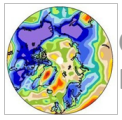
```
ftp ftp.cgd.ucar.edu
login: anonymous, pass: email
cd incoming
get [file]
```

- Visualize on laptop



# Evaluating the Diagnostics

- Look at Cloud Forcing (zonal means, set 3)
- SWCF, LWCF: difference from observations
- Note here and in the tables there are SEVERAL sets of observations.
- Which is correct? Is the model 'biased'?
  - How do you decide?



# Additional Exercise: 2 runs

As an additional exercise, can compare 2 runs

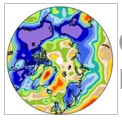
Modify Script Accordingly (control = 'OBS')

Set paths and climatology creation to true

Use either:

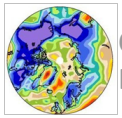
(a) my test run: `/gpfs/ptmp/andrew/test`

(b) run w/ different physics: `/gpfs/ptmp/andrew/test_c0`



# Exercises

- If you compare to my run: is it identical?
- If you compare to a modified run: what is different? We will return to this on Thursday.



# Diagnostics

- Can also load climatology files into NCVIEW for example (these are just like CAM history files).
- Often useful for post-processing
- As an exercise, look at the climatology file:
  - First using `ncdump –h [file]`
  - Second, using NCVIEW (`ncview [file]`)